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SIXTY–THIRD REPORT OF THE STATE GEOLOGIST

(1969–1970)

CALIFORNIA DIVISION OF MINES AND GEOLOGY
1416 Ninth Street, Sacramento, California 95814

1970

STATE OF CALIFORNIA ▪ THE RESOURCES AGENCY ▪ DEPARTMENT OF CONSERVATION

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Sixty-Third Report of the State Geologist

ACTIVITIES OF THE CALIFORNIA DIVISION OF MINES AND GEOLOGY

July 1, 1969, through June 30, 1970

Wesley G. Bruer, State Geologist and Chief
California Division of Mines and Geology
The Resources Building, Sacramento

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DIVISION OF MINES AND GEOLOGY

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DECEMBER 7, 1970

Honorable James G. Stearns, Director
Department of Conservation
Sacramento, California

Sir:

I am pleased to present the 63d Report of the State Geologist. This annual report is a summary of the activities of the Division of Mines and Geology for the period July 1, 1969, through June 30, 1970.

This report could as well be titled "The 63d Report of Several State Geologists." Dr. Ian Campbell was State Geologist for four months of the period prior to his retirement October 31, 1969, after more than ten years of illustrious service in that position. Deputy Director John Mayfield, Jr., performed the duties of Chief of the Division from November 1, 1969, until the temporary appointment of the undersigned on December 17, 1969.

Throughout the unavoidable disruptions occasioned by leadership changes, reorganization, and the physical relocation of various staff members and functions, Division personnel continued to carry out their duties and to meet their responsibilities with the dedication which has characterized the organization through the years. While much of this report on operations and accomplishments quite accurately reads like "business as usual," that fact alone represents a considerable accomplishment. Thus, it is with justifiable pride in the people of the Division that I present our report.

Respectfully submitted,

Wesley G. Bruer

Wesley G. Bruer
State Geologist and Chief,
California Division of Mines and Geology

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RONALD REAGAN, Governor

DEPARTMENT OF CONSERVATION

DIVISION OF MINES AND GEOLOGY

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STATE OF CALIFORNIA—RESOURCES AGENCY

RONALD REAGAN, Governor

DEPARTMENT OF CONSERVATION

DIVISION OF FORESTRY
DIVISION OF MINES AND GEOLOGY
DIVISION OF OIL AND GAS
DIVISION OF SOIL CONSERVATION

SACRAMENTO, CALIFORNIA
1416 Ninth Street

December 8, 1970

Honorable Norman B. Livermore, Jr.
Secretary for Resources
The Resources Agency
Sacramento, California

Sir:

I am transmitting to you for review and for presentation to Governor Ronald Reagan, the 63rd report of the State Geologist, and Chief, Division of Mines and Geology, for the 1969-1970 fiscal year.

This report covers a particularly difficult period for the Division. During the fiscal year 1969-1970, it had three administrative officers, reorganized its staff, redirected its mission, and prepared to move its principal offices.

Despite this, the Division of Mines and Geology has increased its service to local agencies, particularly under cooperative agreements, has assisted the mining industry in such difficult areas as pollution and water quality, and has made steady progress with the technical projects now underway, especially those relating to environmental hazards and public safety.

I think you will be pleased with its record.

Respectfully,

James G. Stearns

James G. Stearns, Director
Department of Conservation

CONTENTS

Mission and Objectives of the California Division of Mines and Geology 9

Statutory Authority 9

State Mining and Geology Board 10

Administration and Organization. 13

Organization Chart of The Resources Agency. 14

Organization Chart of the Division of Mines and Geology 15

Personnel. 16

Geologic Hazards and Mineral Resources Conservation Program. 18

Geologic Hazards Element. 18

Basic Geology Element 21

Mineral Resources Element 24

Marine Geology Element. 29

Geologic Data Element 30

Cooperative Activities 32

Budget Summary 37

Future Plans 38

MISSION AND OBJECTIVES OF THE CALIFORNIA DIVISION OF MINES AND GEOLOGY

Briefly stated, the objective of the Division is to meet the geologic and mineral resource needs of California on a priority basis in cooperation with other public agencies and the private sector.

To most effectively achieve this objective, present and future needs must be identified. This requires comprehensive forecasting and advance planning. The Division took significant steps toward developing the capability to meet these requirements during 1969-70. Extensive progress is anticipated for the coming year in these areas and in the establishment of criteria for determining priorities.

The statement of Division objectives, as formalized in January 1970, is:

> To collect, develop, and disseminate geologic information and actively encourage the application of a broad, useful understanding of the geology of California in cooperation with other agencies and the private sector; to thereby advise and assist in the wise management of the earth's crust, its terrain, and its mineral resources as a service to the safety, economy, and enjoyment of the people of the State.
>
> In so doing, it is the further objective of this Division to establish and maintain *the* standard of excellence for similar organizations throughout the world.

Statutory Authority

The Division operates under the authorities set forth in Chapter 2 of Division 1 and Chapters 1 and 2 of Division 2 of the Public Resources Code. The significant sections are summarized here:

Section	Substance of Law
601, 607	Establishes Department of Conservation in the Resources Agency, and Division of Mines and Geology and three other Divisions in the Department of Conservation.
660-667	Establishes State Mining and Geology Board and its responsibilities.
680	Establishes State Geologist as Chief of Division.
2201	State Geologist shall employ geologists and qualified specialists to do Division's work.
2203	State Geologist shall submit an annual report.
2204	State Geologist may receive and manage gifts on behalf of State.

Section	Substance of Law
2005	The State Geologist may:
	Study mineral resources, mineral industries, and geology of the state.
	Collect mineral statistics.
	Collect geological and mineralogical specimens and models to constitute Division's exhibits.
	Provide technical library to be Division's library.
	Maintain, in effect, a bureau of information on the state's mineral industries.
	Conduct studies of geologic hazards in urban areas, including activities under cooperative agreements.
	Maintain a laboratory to perform physical and chemical tests and analyses.
	Issue reports and maps on the geology of the state and the statistics and technology of the state's mineral industries.

State Mining and Geology Board

This Board, which is within the Department of Conservation, consists of seven members "associated with or having broad knowledge of the mineral industries of this state, of its geologic resources, or of related technical and scientific fields..."

The Public Resources Code states that "The Board shall represent the State's interest in the development, utilization, and conservation of the mineral resources of the state, and in the development, collection, collation, and dissemination of geological information necessary to the understanding and utilization of the state's terrain, and information pertaining to earthquake and other geologic hazards. It may establish policies conforming to the provisions of State statutes to govern the administration of the Division of Mines and Geology." The Board reviews Division policies and programs from time to time at its meetings.

The State Geologist, who serves as Chief of the Division, is "appointed under provisions of the State Civil Service Act by the Director (of the Department of Conservation) upon nomination by the Board."

During the 1969-70 fiscal year, the Board met on:

August 5, 1969	San Francisco
November 25, 1969	San Francisco
December 16, 1969	Sacramento
January 13, 1970	San Francisco
February 10, 1970	San Francisco
February 20, 1970 (Executive Session)	San Francisco
March 10, 1970	Los Angeles
March 31, 1970	Sacramento
June 9, 1970	Sacramento

During the year, the Board:

Considered the Division's 1970-71 budget.

Endorsed the formation of the State Legislature's Joint Committee on Seismic Safety.

Reviewed the State Geologist selection process.

Adopted Rules of Order for the Board.

Elected Dr. Paul C. Henshaw as Chairman, replacing Mr. Philip R. Bradley, who had served as Chairman since 1944.

Adopted a resolution of appreciation to Mr. Bradley.

Elected Dr. Richard H. Jahns as Vice-Chairman of the Board.

MINING AND GEOLOGY BOARD MEMBERS

Appointment Dates and Terms

	CURRENT APPOINTMENT EFFECTIVE JANUARY 15 and (FIRST APPOINTMENT)	TERM ENDS JANUARY 15
CLARENCE R. ALLEN Division of Geological Sciences California Institute of Technology Pasadena 91109	1969 (February 17, 1969)	1973
PHILIP R. BRADLEY Consulting Mining Engineer 2801 Oak Knoll Terrace Berkeley 94705	1968 (1943)	1972
EDMOND F. BROVELLI President, Basalt Rock Company Post Office Box 2540 Napa 94558	1967 (February 1962)	1971
PAUL C. HENSHAW President, Homestake Mining Company 650 California Street San Francisco 94108	1968 (May 10, 1968)	1972
RICHARD H. JAHNS Dean, School of Earth Sciences Stanford University Stanford 94305	1966 (February 10, 1966)	1974
T. HOWARD RODGERS Vice-President, Chanslor-Western Oil and Development Company 4549 Produce Plaza Los Angeles 90058	1967 (July 17, 1959)	1971
KARL V. STEINBRUGGE Structural Engineer Pacific Fire Rating Bureau 461 California Street San Francisco 94104	1969 (February 17, 1969)	1973

ADMINISTRATION AND ORGANIZATION

State Geologist Ian Campbell reached mandatory retirement age in October 1969 and terminated his civil service career. Wesley G. Bruer was appointed State Geologist and Chief of the Division on a temporary basis in December 1969.

The organization of the Division was restructured into more clearly identified line and staff functions in January 1970. The reorganization, in part, reflects the continued increase in assistance to local governments, particularly in geologic hazards and other urban geology efforts. Greater authority is now delegated to district offices to provide more effective supervision of, and logistical support to, field activities. Increased staff support includes a Program Group whose primary responsibilities are Division-wide forecasting and planning.

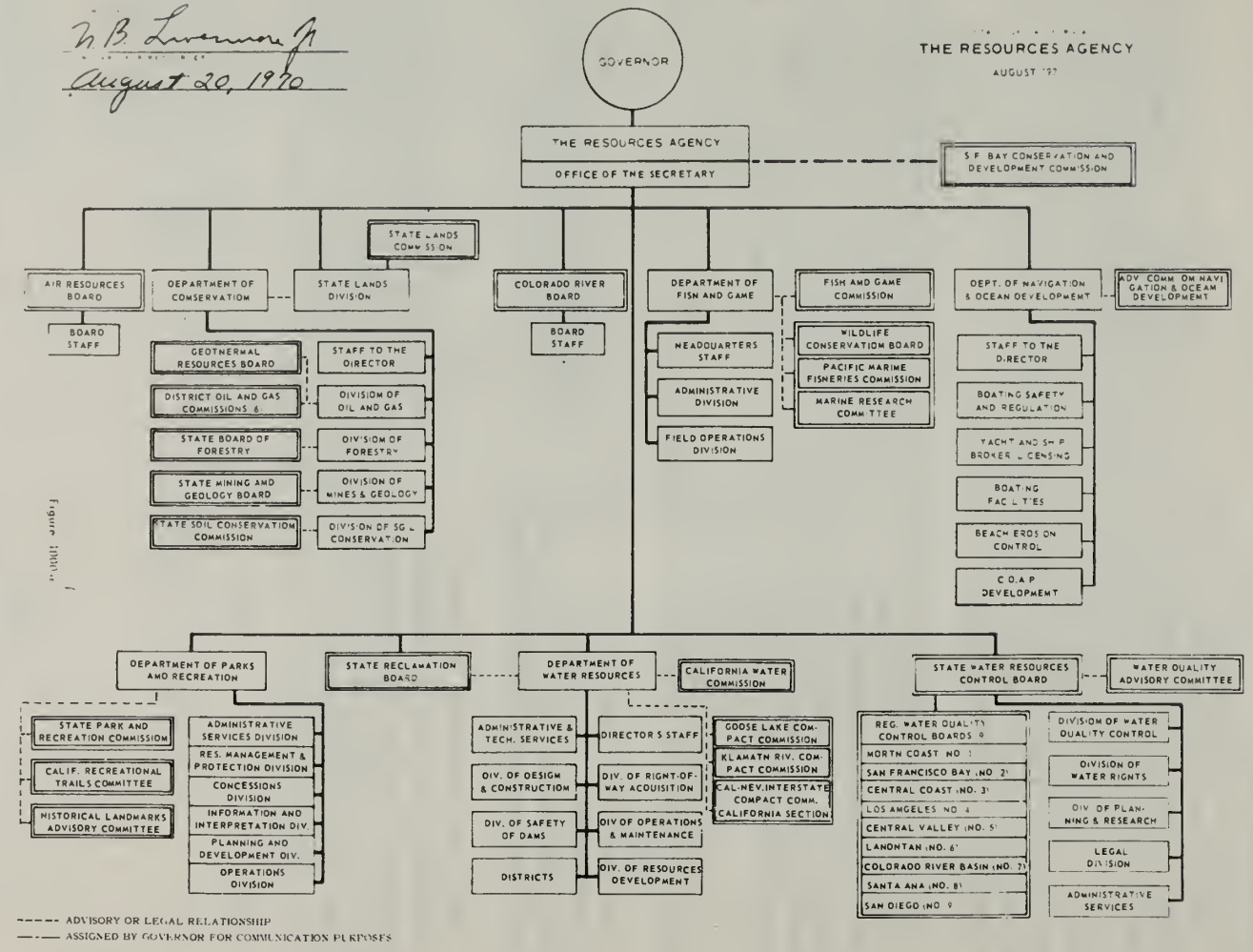
All Division projects and activities underway were evaluated by the Program Group for conformance with over-all Division objectives and priorities. Recommendations for continuing, modifying, accelerating, recessing, or terminating each project and activity were implemented after further discussion with the staff members most immediately affected. Firm time schedules were established for all viable projects.

The broadening spectrum of Division concerns was reflected by the addition of Marine Geologist and Seismologist positions to the staff.

Recommendations by both the legislative and executive branches of State government to the effect that the headquarters function of the Division be moved from San Francisco to Sacramento were being carried out and had been nearly completed by the end of the fiscal year.

The headquarters relocation facilitated a budget-mandated reduction of 4.3 positions and a transfer of 4 additional positions to the Department of Conservation as the Department assumed a greater role in providing administrative services to the Division. No technical positions were eliminated in this process. A sizable district office and the Division Library, Mineral Exhibit, and Geochemical Laboratory remain in San Francisco.

Ronald B. Livermore Jr
August 20, 1970



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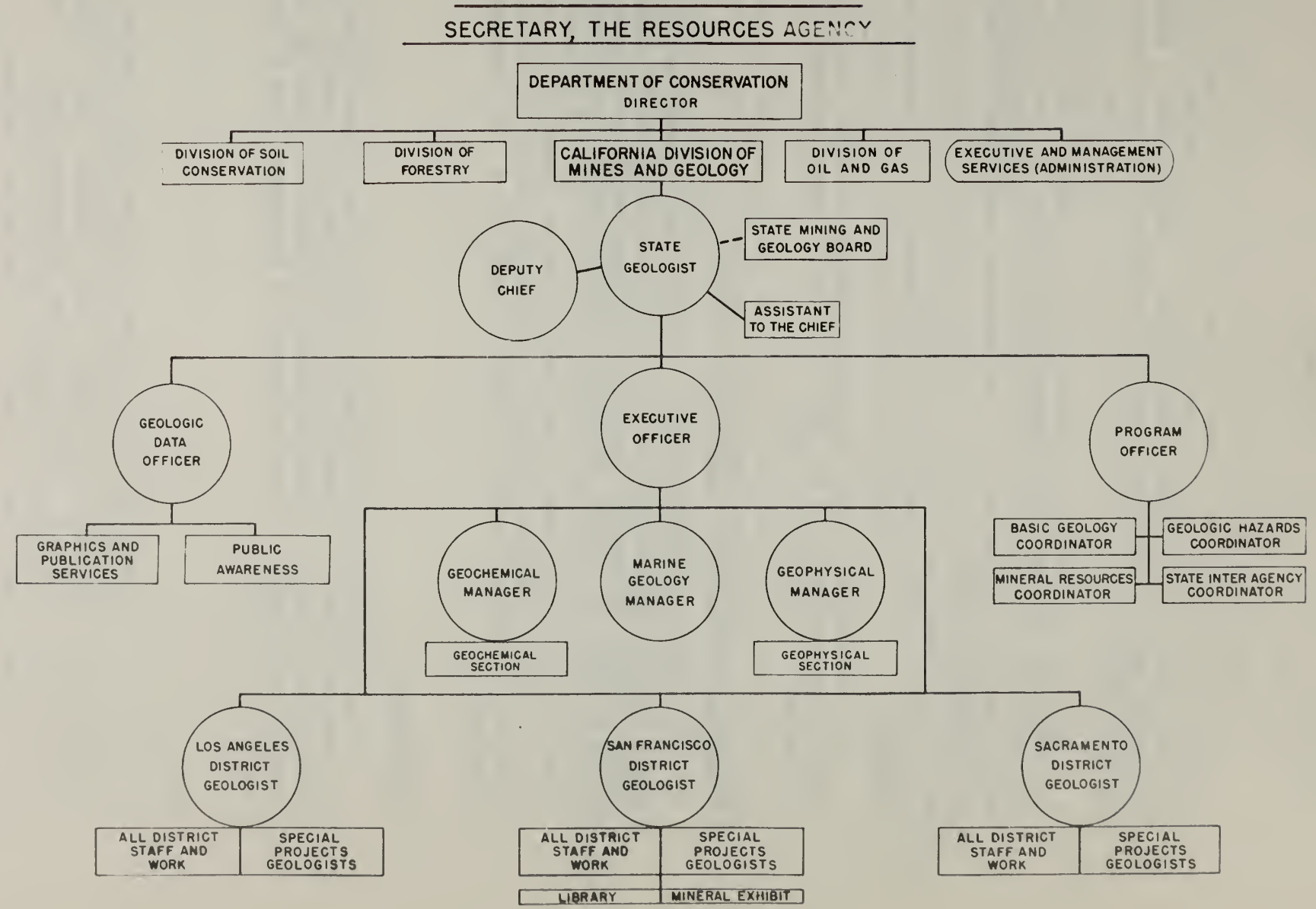
ORGANIZATION
CALIFORNIA DIVISION OF MINES AND GEOLOGY
JUNE 30, 1970



PERSONNEL

The Division is directed by the State Geologist and Chief, Division of Mines and Geology, who is assisted and advised by the Deputy Chief, the Executive Officer, the Program Officer, and the Geologic Data Officer. An additional 34 geologists, 2 geochemists, 1 geophysicist, 1 marine geologist, and 30 supporting technical, editorial, and clerical personnel are employed.

Upon the retirement of Division Chief Ian Campbell on October 31, 1969, the duties of the Chief were assumed by the Deputy Director of the Department of Conservation, John M. Mayfield, Jr., for the period of approximately six weeks prior to the temporary appointment of Wesley G. Bruer on December 17, 1969.

Retired

Dr. Ian Campbell, State Geologist, October 31, 1969; Lucy O'Brien, Senior Stenographer, June 30, 1970; Beatrice L. Reynolds, Senior Stenographer, September 12, 1969;

Resigned or Transferred to Other State Agencies

Linda Athey, Stenographer II; Alexander Cano, Accounting Technician; Eugene Carter, Geologic Aide; John R. Cassell, Business Service Officer; Julie Donnelly, Geologic Aide; James R. Evans, Associate Geologist; Thomas E. Gay, Jr., Senior Geologist; Arman Ghazarian, Clerk; Dennis Johnson, Clerk; Alice B. Kelly, Stenographer II; Robert W. Konigstedt, Stock Clerk; Anthony Lynch, Clerk; Melanie Megas, Clerk-Typist; Wayne Spar, Clerk II; Elgar Stephens, Associate Geophysicist; Matti S. Tavela, Associate Geochemist; Theodore Voyvodick, Clerk II; and John S. Yee, Geological Draftsman.

Transferred

From San Francisco to Sacramento--Mary Louise Burgess, Supervising Stenographer; Dorris P. Campbell, Senior Stenographer; Gordon B. Oakeshott, Deputy Chief; Robert Streitz, Associate Geologist; and Bennie W. Troxel, Supervising Geologist. From Los Angeles to Sacramento, Tom M. Wootton, Assistant Geologist.

Hired

Paul L. Anderson, Associate Geochemist; Susan Alburn, Geologic Aide; Linda C. Athey, Stenographer II; LeVern W. (Bill) Cutler, Librarian III; Julie Donnelly, Geologic Aide; Eugene Carter, Geologic Aide; Catherine Gevaller, Clerk-Typist I; Raymond D. Grimm, Delineator; Carl J. Hauge, Assistant Geologist; Michael E. Huffman, Assistant Geologist; H. H. Majmundar, Associate Geochemist; Vivian Muston, Delineator;

Elgar Stephens, Associate Geophysicist; Jeffrey O. Tambert, Geological Draftsman; Margaret W. Turner, Clerk-Typist; Tom M. Wootton, Assistant Geologist; Edward E. Welday, Senior Marine Geologist; Lorraine Yim, Graphic Artist; and Willard Zurcher, Laboratory Technician.

Promoted

Wilma L. Ashby to Senior Clerk-Typist; Harold B. Goldman to Senior Geologist; Catherine A. Govaller to Clerk-Typist II; Josephine M. Territo to Senior Clerk-Typist.

Academic Achievements

Junior Geologist Allan G. Barrows took his Doctor of Philosophy degree from the University of California at Los Angeles; the subject of his thesis was the Geology of the Hamburg-McGuffy Creek area, Siskiyou County, California, and Petrology of the Tom Martin Ultramafic Complex.

Student Aid Activities

During the fiscal year, the Division utilized the services of seven University students through the College Work-Study Program, using Federal Higher Education Facilities Act funds. Summer help was also employed by the Division under various student assistance programs. These included 2 Youth Aides, 2 Government Internes, and 3 Neighborhood Youth Corps enrollees. These students provided many valuable services in the Library, the Map Room, the Laboratory, and in general clerical activities, enabling the Division to reduce a backlog of tasks requiring sub- and semi-professional help.

GEOLOGIC HAZARDS AND MINERAL RESOURCES CONSERVATION PROGRAM

Geologic Hazards Element

Increasing emphasis is being placed upon geologic problems in California as urban and suburban development progress toward areas with more complex geologic foundation conditions. It is the purpose of the Geologic Hazards Element to provide a measure of safety to the public by supplying data which will inform and assist in matters that involve the geologic environment. Particular attention is paid to those areas planned or considered for development so that developers and builders may be equipped to deal with such matters as landslides, subsidence, and earthquake hazards.

Four categories are used to divide the work within this part of the program: Geologic Data Gathering and Dissemination; Special Problems in Environmental Geology; Seismic and Fault Movement Investigations; and Services to Other Units of State Government.

Geologic Data Gathering and Dissemination

Basic to the Geologic Hazards effort is the gathering, interpreting, and publishing of data concerning urban development. This is being done through geologic mapping at scales of 1:24,000 and larger in areas of current and imminent need. Assistance, in the form of cooperative agreements, including cost sharing with local governmental agencies, enables the Division to work on a far broader front than would otherwise be possible. Cooperative agreements are currently in effect with the Counties of Los Angeles, Orange, Santa Clara, and Sonoma and with the Cities of Hayward, Hollister, and San Diego. This is discussed in greater detail in the section on Cooperative Activities.

The following is a list of urban mapping projects, on which a total of 10.6 man-years of Division staff time was expended.

Urban Mapping Projects Active During 1969-70

Area	County	Geologist	Progress
*City of San Diego	San Diego	Kennedy	Additional mapping completed
*Newhall-Saugus	Los Angeles	Saul and Wootton	Mapping continued
Lake Tahoe Basin	Placer and El Dorado	Burnett and Matthews	Preliminary report reviewed
*Sonoma County	Sonoma	Huffman	Reconnaissance report completed
*Hayward Hills	Alameda	Burnett	Initiated and completed

*Cooperative venture

Urban Mapping Projects Active During 1969-70 (continued)

Area	County	Geologist	Progress
7 1/2 Minute Quadrangles			
*Mt. Wilson (west central)	Los Angeles	Saul	Mapping completed
*Mt. Wilson (east central)-Azusa (south half)	Los Angeles	D.Morton	Released to open file; processed for publication
Walnut Creek (SW quarter)	Contra Costa	Saul	Processed for publication
San Rafael	Marin	Rice	Mapping continued
*Mt. Baldy (south half)-Glendora (SW quarter)	Los Angeles	Streitz	Map and report nearly completed
*Oat Mountain (SE quarter)	Los Angeles	Saul	Mapping completed
*Thousand Oaks	Ventura	Weber	Mapping continued
*Calabasas	Los Angeles	Weber	Mapping continued
*Cañada Gobernadora	Orange	P.Morton	Mapping completed
*El Toro (south half)	Orange	Fife	Mapping completed
*Dana Point	Orange	Edgington	Mapping completed
*San Juan Capistrano	Orange	P.Morton, Fife, and Edgington	Mapping commenced

*Cooperative venture

Special Problems in Environmental Geology

In addition to the more general information made available through the urban mapping program, special attention was given to known problem areas through detailed mapping or special studies. One and one-half man-years were expended on these projects.

Special Problems Projects Active During 1969-70

Wrightwood Mudflows: D.Morton. Field work completed. Abstract published.

Ventura and Santa Barbara Counties Geologic Hazards--Storm of 1969: Weber. Completed.

Major Landslides in San Gabriel Mountains: Streitz-D.Morton. Published as Map Sheet 15.

Wright Mountain Landslide: D.Morton. Report completed and revised.

Landsliding in Coastal Regions of California: Cleveland. Field and office work continued.

Quality Requirements for Mine Waste Water Under the Porter-Cologne Act 1969, A Review: Evans and Streitz. Text in review.

Waste Disposal Site for North Lake Tahoe: Matthews. Site investigated, tested, and evaluated.

Seismic and Fault Investigations

In line with the continuing analysis of crustal strain and seismicity in California, 2.6 man-years were expended on the following projects.

Projects Active During 1969-70

Project	Geologist	Progress
Elsinore fault, active breaks	Gray	Preliminary office work complete; field checks started.
San Andreas fault, San Bernardino area	D.Morton	Continued field work.
*Calaveras fault, Hollister	Rogers	Continued creep measurements; prepared progress report.
*Newport-Inglewood fault zone	Barrows	Preliminary report completed.
Cracking damage, McKinley School, Santa Barbara	Kahle	Report prepared on tectonic origin.
Regional analysis of geologic hazards	Kahle	Preliminary epicenter map of California (1:1,000,000); updated through 1969.
Earthquake damage analysis	Hill, Kahle, Rogers	Made on-site investigations of several earthquakes.
Santa Rosa earthquake. October 1969	Various	Published report in March issue of MINERAL INFORMATION SERVICE

Service to Other Units of State Government

An evaluation service, available to other units of State Government, is provided by the Division where geologic matters are of concern. A total of 1.4 man-years were expended for this work during the year.

Services or Projects Active During 1969-70

Service	Geologist	Remarks
Thermal power plant siting	Goldman and Koenig	Completed preliminary report
Real estate tract reviews	Kelley	For the Department of Real Estate (under contract)

In addition to these services, which are furnished on a continuing basis, the Division provided a wide variety of short-term evaluations to other agencies upon request.

Basic Geology Element

The results of the expenditure of 18.5 man-years of manpower on projects provided the following.

Geologic Map of California (scale 1:250,000 or approximately 4 miles per inch)

The San Bernardino Sheet, one of the final two map sheets in the 28-sheet atlas, was released. The other, the Los Angeles Sheet, was nearly ready for release. Field work on the revisions to the Alturas and Death Valley Sheets continued. The Master Legend and Formation Index were readied for printing (1.97 man-years).

State Planning Geologic Map (scale 1:750,000 or approximately 12 miles per inch)

Approximately 0.6 man-year was expended during 1969-70 as work continued on the State Planning Map.

Areal Geology Projects

This tabulation includes those projects active during fiscal 1969-70. A total of approximately 5.5 man-years was expended.

Project	Geologist	Progress
Ono quadrangle	D.Morton et al	Published as Bulletin 192.
Lakeview quadrangle	D.Morton	Submitted for publication.
NE Shoshone quadrangle	Chesterman	Submitted for review.
Shadow Mountains	Troxel and Gundersen+	Processed for publication as Preliminary Report 12.
Romoland quadrangle	D.Morton	Field work completed.
Haiwee Reservoir quadrangle	Stinson	Completed for publication processing.
Keeler quadrangle	Stinson	Completed field work.
Bodie quadrangle	Chesterman and Gray	Completed field work.
Coccoliths at San Diego	Bukry+ and Kennedy	Published in Special Report 100
Facies relations of Eocene strata, San Diego	Kennedy and Moore+	Submitted for publication
Structural geology of southern Mother Lode area	Evans	Field work and first draft completed.
San Luis Obispo area	Hart	Continued field work
Matterhorn Peak quadrangle	Chesterman	Submitted for review
Maturango Peak quadrangle (reconnaissance)	Kahle and Gray	Field work completed
Coso Peak quadrangle (reconnaissance)	Stinson and Streitz	Field work completed

+Outside personnel

Geophysical Projects

Through funding by the Army Map Service plus normal use of the Division staff, 1.5 man-years were expended on the Bouguer Gravity Anomaly Map of California. Another 0.5 man-year was expended on the Geodimeter Program, and 0.2 man-year was used on geophysical support work for the projects listed:

Geophysical Support Projects

Title	Staff	Progress
Bouguer Gravity Map	Staff	San Luis Obispo and Redding sheets submitted for publication; Santa Rosa and Ukiah in preparation. Gravity data gathered for all other unpublished sheets.
Geodimeter Program	Gasch and Chapman	Continued field measurements and evaluation of program.
Bodie Hills	Chapman	Prepared data and maps.
Tahoe Basin	Chapman and staff	Prepared gravity map and interpretation.
Coso Hot Springs	Chapman and staff	Prepared gravity map and interpretation.
Port Wine	Chapman and staff	Continued interpretation of data.

Geochemical Projects

During the last part of the fiscal year, primary emphasis was shifted from geochemical projects, per se, to geochemical support of other Division activities, particularly of field projects. A total of 4.3 man-years was expended on geochemical studies during the year.

A Perkin-Elmer 403 Atomic Absorption Spectrophotometer was installed and is being used for quantitative metal analyses.

Geochemical Project Functions

Title	Staff	Progress
Geochemistry of mercury	Tavela, C.Smith, McClure	Continued study. Developed new procedures for sampling and analysis.
X-ray spectroscopic rock analysis	Anderson, Lofgren	Developed major and minor element analytical system (except for sodium and magnesium)

Geochemical Support Functions

Sample preparation and analyses for copper, lead, and zinc as a part of the Engels-Walker project: for A.Smith.
Mineral separations for potassium-argon geochronology study of the Bodie area: for Chesterman and Gray.
X-ray diffraction analyses of the ultramafic rocks of the southern Mother Lode: for Evans.
X-ray diffraction and X-ray spectroscopic analyses of San Francisco Bay oyster shells for use in cement: for Welday.
Major and minor element rock analyses on samples from the Coso Hot Springs area: for Koenig.

Management and Support

A total of 3.3 man-years was expended in support of the preceding Projects.

Mineral Resources Element

A major objective of the Division is to provide information on the mineral resources of California in the interests of the people of the state. In a very real sense, this information serves to protect the state's mineral resources for wise use—a major conservation objective. Continued increases in both population and in per capita consumption generate increased demand for minerals. The Division endeavors to meet this demand by planned investigation and delineation of new mineral deposits and by development of more efficient field and laboratory techniques. In addition to the principal active projects listed here, the Division has been involved in studies concerning factors which will affect mineral production in California, such as mine water discharge and mine and mill waste for construction use.

On January 1, 1970, the Porter-Cologne Water Quality Control Act became effective. This Act is a revision of the State's water quality control laws and is administered by the State Water Resources Control Board. The Division has worked with the Board and other State agencies to obtain effective yet fair requirements which will regulate mine drainage water pollution.

Mine water discharge requirements, which allowed continued production with a minimum of water quality impairments, were established for approximately fifteen mines. Satisfactory requirements were established for the Oriental mine, which is one of the very few remaining underground gold mines in California, as well as for several other mines--including placer gold, sand and gravel, mercury, and asbestos producers.

A statewide study of mine and mill waste as a potential source of rock construction material has also been undertaken by the Division. Part A of this study, which covers the northern part of the state, is partly completed.

For all projects listed under the Mineral Resources Element, a total of 4.2 man-years was expended.

County Mineral Resource Investigations

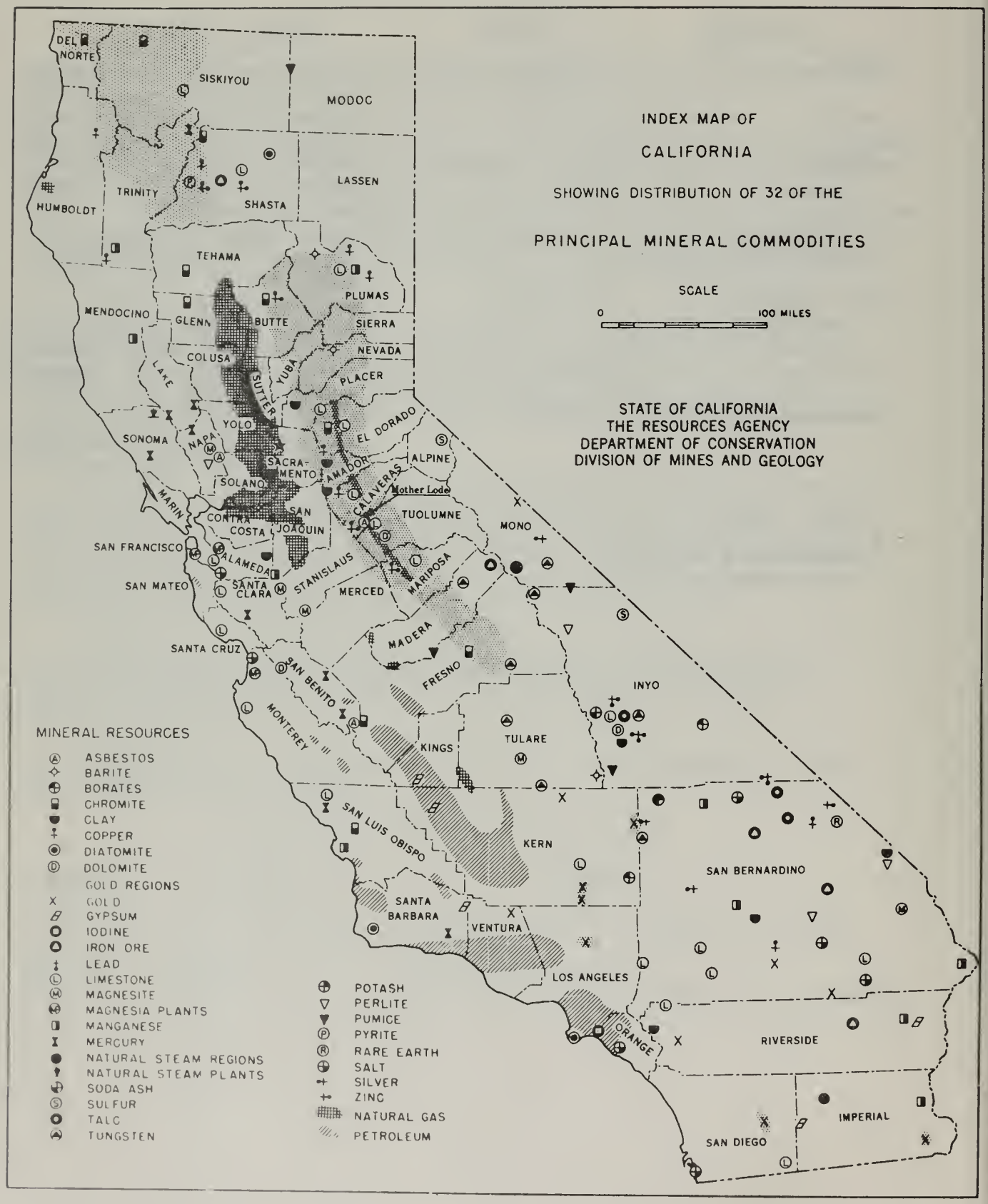
County	Geologist	Progress
Riverside	Saul, Evans, Gray	Reviewed--returned to authors for minor revisions.
Imperial	P.Morton	Reviewed and revised.
Sutter	Kiessling	Map revised--awaiting publication processing.

Commodity Investigations

Commodity	Geologist	Project: Progress
Rare earths	D.Morton, Baird[+], Watson[‡]	Mountain Pass Carbonatite Study: Work completed. Resume presented at Geological Society of America meeting March 1970.
Limestone	Evans, Gray, Hart	Limestone and Dolomite in California: Revised 2 sections and completed one.
Rock Products-- Sand, Gravel, Stone	Goldman	Sand and Gravel Resources in San Diego: Released to open file.
Rock Products-- Sand, Gravel, Stone	Kiessling	Simi Conglomerate as Source of Concrete Aggregate, Los Angeles Area: Map and report completed.
Silver	Weber	Calico Silver District: Continued field and office investigation.
Geothermal Resources	Koenig	Survey of Exploration for Geothermal Resources in Western United States: Work completed.

[+]Pomona College

[‡]University of California at Los Angeles


INDEX MAP OF
CALIFORNIA
SHOWING DISTRIBUTION OF 32 OF THE
PRINCIPAL MINERAL COMMODITIES
SCALE
0
100 MILES
STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF CONSERVATION
DIVISION OF MINES AND GEOLOGY
DEL NORTE
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HUMBOLDT
SHASTA
LASSEN
TEHAMA
PLUMAS
MENDOCINO
GLENN
BUTTE
SIERRA
NEVADA
COLUSA
LAKE
SUTTER
YUBA
PLACER
YOLO
EL DORADO
SONOMA
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AMADOR
ALPINE
SOLANO
CALAVERAS
Mother Lode
MARIN
CONTRA COSTA
SAN JOAQUIN
TUOLUMNE
MONO
SAN FRANCISCO
ALAMEDA
STANISLAUS
MARIPOSA
SAN MATEO
SANTA CLARA
MERCED
MADERA
SANTA CRUZ
FRESNO
INYO
SAN BENITO
MONTEREY
KINGS
TULARE
SAN LUIS OBISPO
KERN
SAN BERNARDINO
SANTA BARBARA
VENTURA
LOS ANGELES
ORANGE
RIVERSIDE
IMPERIAL
SAN DIEGO
MINERAL RESOURCES
ASBESTOS
BARITE
BORATES
CHROMITE
CLAY
COPPER
DIATOMITE
DOLOMITE
GOLD REGIONS
GOLD
GYPSUM
IODINE
IRON ORE
LEAD
LIMESTONE
MAGNESITE
MAGNESIA PLANTS
MANGANESE
MERCURY
NATURAL STEAM REGIONS
NATURAL STEAM PLANTS
SODA ASH
SULFUR
TALC
TUNGSTEN
POTASH
PERLITE
PUMICE
PYRITE
RARE EARTH
SALT
SILVER
ZINC
NATURAL GAS
PETROLEUM

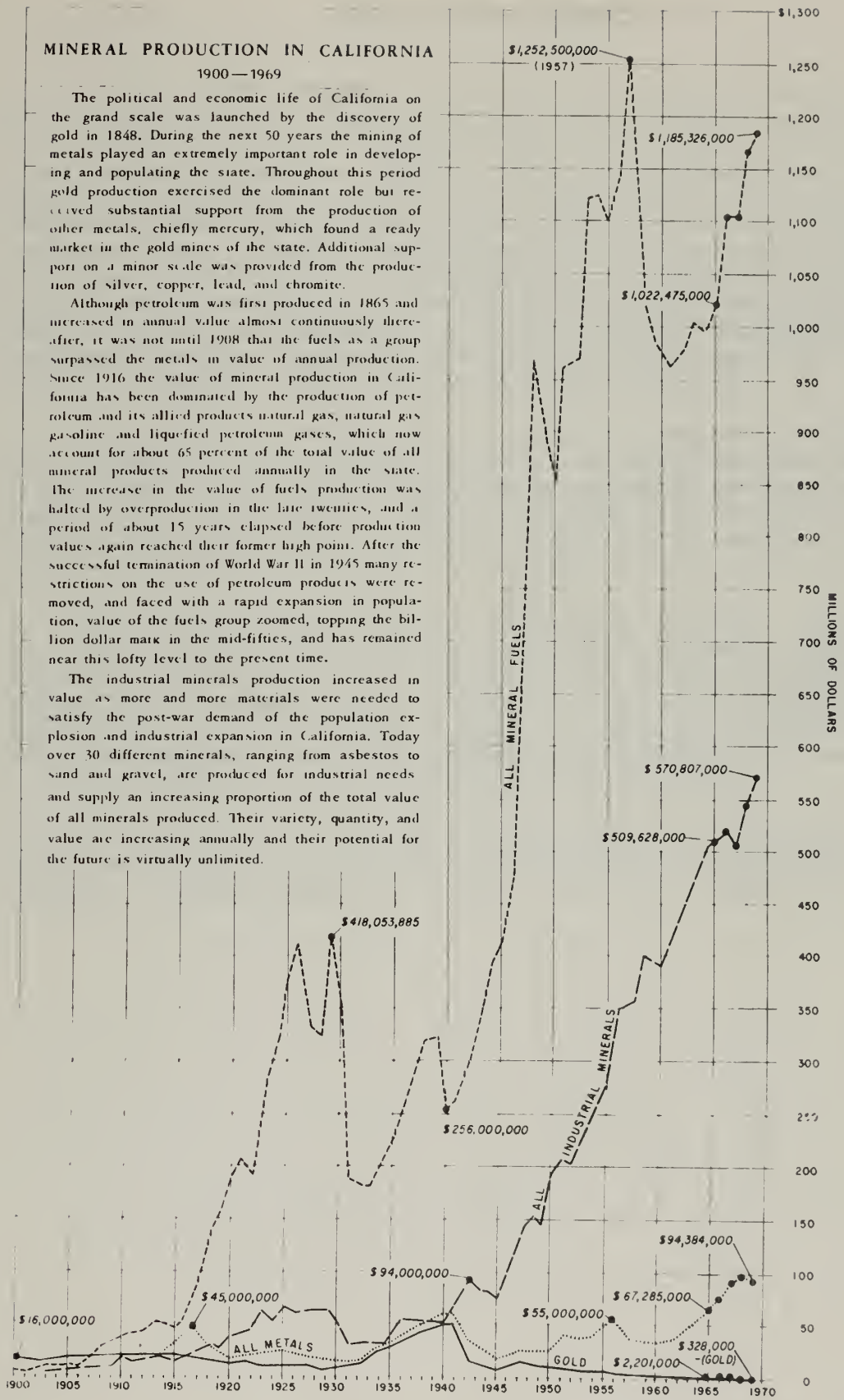
MINERAL PRODUCTION IN CALIFORNIA

1900—1969

The political and economic life of California on the grand scale was launched by the discovery of gold in 1848. During the next 50 years the mining of metals played an extremely important role in developing and populating the state. Throughout this period gold production exercised the dominant role but received substantial support from the production of other metals, chiefly mercury, which found a ready market in the gold mines of the state. Additional support on a minor scale was provided from the production of silver, copper, lead, and chromite.

Although petroleum was first produced in 1865 and increased in annual value almost continuously thereafter, it was not until 1908 that the fuels as a group surpassed the metals in value of annual production. Since 1916 the value of mineral production in California has been dominated by the production of petroleum and its allied products natural gas, natural gas gasoline and liquefied petroleum gases, which now account for about 65 percent of the total value of all mineral products produced annually in the state. The increase in the value of fuels production was halted by overproduction in the late twenties, and a period of about 15 years elapsed before production values again reached their former high point. After the successful termination of World War II in 1945 many restrictions on the use of petroleum products were removed, and faced with a rapid expansion in population, value of the fuels group zoomed, topping the billion dollar mark in the mid-fifties, and has remained near this lofty level to the present time.

The industrial minerals production increased in value as more and more materials were needed to satisfy the post-war demand of the population explosion and industrial expansion in California. Today over 30 different minerals, ranging from asbestos to sand and gravel, are produced for industrial needs and supply an increasing proportion of the total value of all minerals produced. Their variety, quantity, and value are increasing annually and their potential for the future is virtually unlimited.



Marine Geology Element

An active marine geology program was initiated in April 1970 with the employment of Senior Marine Geologist Edward Welday. An assessment of the available geologic information of offshore California has been the first step in the program. Through library research and visits to various schools and governmental agencies, more than 200 research papers on California marine geology were located. Cruise tracks and sampling information were obtained. During these visits, liaison was established to monitor current activities of these groups and to participate in certain future activities. The meetings of such advisory groups on the coastal zone as the Navigation and Ocean Development Commission, the California Advisory Commission on Marine and Coastal Resources, and the State Environmental Quality Study Council were monitored.

Senior Geologist Fenelon Davis continued to represent the Department of Conservation on the Interagency Council on Ocean Resources (ICOR) Planning Team. A suggested outline for a chapter in the California Comprehensive Ocean Area Plan (COAP) titled "Mineral Resources in the Landward Coastal Zone" was prepared and submitted to the ICOR planning staff in June 1970.

An investigation was made of the dangers of tsunamis. The problems of predicting wave heights, run-up, and possible extensive damage were studied. Although only about 2 percent of the recorded earthquakes are accompanied by tsunamis, there is a possibility of great destruction and loss of life resulting from giant waves. A historical review and survey of recent damages to California coastal areas indicate that precautions should be taken to insure that destruction is minimized.

Shell deposits in south San Francisco Bay were investigated. Shell mining activities were monitored, and an estimate of the value of the materials mined was made at the request of the State Lands Division.

Geologic Data Element

The objective of this Element is to inform California's public and its industry about all phases of the geology and the mineral industry of the state--especially about its geologic setting, its geologic hazards, and its mineral resources--and the results of work by Division and other earth scientists on these subjects. Facilities include an Information and Sales Desk at each District Office and a Library and a Mineral Exhibit at the San Francisco District Office; and activities involve a varying level of information release by all technical staff members by means of letters, technical and semi-technical talks, and personal contacts. Over the years, this function has stimulated a large amount of economic development in California's mineral industry.

Information Activities

The Division of Mines and Geology is the only agency in California, public or private, that replies to citizens' requests for meaningful scientific answers to questions about such important subjects as earthquakes, landslides, and other geologic and mining matters. The Division staff devotes considerable effort to handling the many inquiries in this area.

Publications Processing

The purpose of this function is to publish and distribute the results of studies made of California geology as promptly, concisely, and attractively--yet economically--as possible. Activities include technical review of contents, drafting of illustrations, editorial processing of manuscripts, coordination of printing of lithography services, management of printing budget, and supervision of distribution system.

The review and editing procedure was revised to reduce the time between completion of the project and public distribution of the report.

Major publications released include: California shaded relief map (in color with a black-and-white 1:2,500,000 geologic map in the corner); Map Sheet 15, Preliminary reconnaissance map of major landslides, San Gabriel Mountains; Bulletin 192, Geology of the Ono quadrangle; Special Report 100, Short contributions to California geology (geologic hazards, volcanology, stratigraphy, and field procedures); Special Publication 35, Preliminary report and geologic guide to Franciscan melanges of the Morro Bay-San Simeon area; Special Publication 34, Geology of placer deposits; Map Sheet 12, Geology of the southeast quarter of the Trinity Lake quadrangle; Map Sheet 13, Geology of the Richardson Springs quadrangle; Special Report 99, Geology of the Dry Mountain quadrangle.

Reprints included: Part B of Bulletin 180, Sand and gravel in central California; Geomorphic map of California; Field Trip C from Bulletin 190, Guide to San Andreas fault from San Francisco to Hollister; and the Chico, Redding, Trona, and Westwood (Susanville) sheets of the State Geologic Atlas.

MINERAL INFORMATION SERVICE, the Division's monthly magazine, sent out twelve issues to its 15,000 paid subscribers (as well as to universities, colleges, and libraries) throughout the world. Articles appearing included: Landslides of southern Point Reyes National Seashore; Diatoms and diatomite; The Geysers geothermal field; The California Geysers; A day at The Geysers in 1861; Japan moving ahead in geothermal development; California slips; A Niagara of lava; Minerals of the Kramer borate district (in two parts); A day in the life of a pump man; An active fault in the city of Hollister; A man of many hats (Ian Campbell retirement issue); Assaying mercury ore today; University research projects on California geology, 1968-69; Gypsum products, plants, and quarries in California; The northern Mojave Desert's little Sahara; Kornelite at Coso Hot Springs; Geology of the California Coast Ranges; Fossils at Rancho La Brea; California's other mineral (oil); Dear Division (letters received during the famous "earthquake scare"); Geology of the Transverse Ranges; Californium-252 to report sea floor minerals; How much water in an inch of rain?; Santa Rosa earthquakes of October 1969; California mining review, 1969; Mineral industry of California, 1968; Mount Rainier restless; Index to graduate theses in California geology, 1969; The floor of San Francisco Bay; New incinerator provides smokeless burning of junked cars; Know more about glaciers; Platinum; Geology of the Peninsular Ranges; Geologic time; Tunisian flood a major disaster. The December issue always includes an index to that year; and, in this fiscal year, a five-year consolidated index was compiled for volumes 16 through 20 and offered separately.

The Sixty-Second Report of the State Geologist and the Directory of Mineral Producers were issued in processed form, and several reports were placed on open file.

COOPERATIVE ACTIVITIES

Los Angeles County

Under the Geologic Hazards Program, the Los Angeles County Engineer and the Los Angeles County Flood Control District provide funds that are matched by the Division to carry on geologic studies in critical areas. Detailed geologic mapping was completed in the west central part of the Mt. Wilson 7 1/2 minute quadrangle, San Gabriel Mountains foothills; the southwest quarter of the Mint Canyon 7 1/2 minute quadrangle, Saugus area; the southwest quarter of the Oat Mountain 7 1/2 minute quadrangle, western San Fernando Valley area; and parts of the Thousand Oaks and the Calabasas 7 1/2 minute quadrangles, Thousand Oaks area.

A topical study on the Newport-Inglewood fault zone was initiated and completed. This study brings together information on major active fault zones located in the populous western Los Angeles basin.

A reconnaissance map of major landslides in the San Gabriel Mountains was published as Map Sheet 15. Detailed geologic maps of the south half of the Azusa and the southwestern part of the Mt. Wilson 7 1/2 minute quadrangles were re-openfiled on a new topographic base. These maps and an accompanying geologic report were processed for publication.

Orange County

As a part of the Geologic Hazards Program, the Orange County Engineer provides funds that are matched by the Division to carry on detailed geologic mapping in rapidly urbanizing county areas. Mapping was completed and prepared for open file in the Dana Point, south half El Toro, and north half Canada Gobernadora 7 1/2 minute quadrangles in the coastal and southern parts of the county. The southwest quarter of the Canada Gobernadora quadrangle was open-filed, joining the southeast quarter which was open-filed in 1968-69.

Field studies in the San Juan Capistrano quadrangle were begun.

Santa Clara County

A matching funds agreement with Santa Clara County provided support for a geologic investigation of the Santa Cruz Mountain area of the county. The emphasis in this continuing investigation is on geologic factors relating to engineering development and land use of the mountain areas.

Sonoma County

A county-wide geologic reconnaissance was the initial product of a matching funds agreement with the Sonoma County Planning Department. Delineation of several critical areas in the reconnaissance study is being followed by detailed geologic mapping in those areas deemed most important to engineering development and land use.

City of Hayward

A geologic investigation was initiated and completed for the Hayward Hills area. The resulting map and accompanying report on geologic and seismic factors affecting slope stability was processed for publication.

City of Hollister

A formal cooperative agreement was entered into with the City of Hollister to study geologic features with the emphasis on active faulting and subsidence. This was an expansion of a continuing Division activity of studying rates of movement and subsidence across and within the Calaveras fault zone.

City of San Diego

Although the matching funds agreement with the City of San Diego has ended, the Division has continued work on reports and topical studies in the general area. Two more additional detailed geologic maps were open-filed. A joint report with the U.S. Geological Survey on Cretaceous and Eocene coccoliths was published in Special Report 100, Short Contributions to California Geology. Coccoliths, remains of fossil marine algae, were used during mapping as aids in the identification and separation of similar lithologic units. A report on facies relations of upper Cretaceous and Eocene formations, another joint effort with the Geological Survey, was processed for publication.

Map compilation and report preparation on the area is being continued.

Salton Sea

Although no new work was initiated on the Salton Sea study under the State-Federal Technical Committee, a paper on the Division's role was presented by James B. Koenig at the National Meeting of the Association of Engineering Geologists in San Francisco. This paper was prepared for publication and will be published as part of a Housing and Urban Development (HUD) document titled, "Engineering Geology in the Urban Environment: A Symposium." Title of this contribution is "Salton Sea: A New Approach to Environmental Geologic Problems."

San Francisco Bay Conservation and Development Commission

In 1966, under a contractual arrangement, the Division made a study of the geology and the mineral resources of San Francisco Bay. Although the formal reports have already been published, the Division continued to serve in an advisory capacity on geological matters. The Deputy Chief served on the Engineering Criteria Review Board, which reviews all projects that include the Bay or the shoreline area of the Bay.

Lake Tahoe Basin

Extensive personal contacts continued in the Bi-State Tahoe Regional Planning Agency and other local governmental agencies in the area. Two reports were prepared on a regional solid waste disposal site in the North Tahoe area and were submitted to the Placer County Department of Environmental Health. Data necessary for these reports were collected in a cooperative study with the California Department of Water Resources.

A final report on the Division's work in Lake Tahoe Basin was in progress at the end of the fiscal year.

State Lands Division

An interagency agreement with State Lands was entered into whereby marine geology services are provided to that agency. This agreement, in part, funds the newly added marine geologist position in the Division. Services include special studies of marine geology in connection with problems before the State Lands Commission and preparation of information on all coastal and offshore activities by private, university, and governmental groups.

University of California at Berkeley

The Division allocated $2,000 to the Seismograph Station for detailed information on earthquakes in California and a similar amount to the Department of Mineral Technology for testing and research on potentially economic clays.

New York State University at Albany

A formal agreement was entered into by which the Division aids in preparation and analysis of geochemical samples from an area of known copper mineralization in Plumas County. This joint venture is a continuation of the Division's interest in the Plumas County copper area.

U.S. Bureau of Mines

The long-standing cooperative efforts of the Bureau and the Division continued in three types of activities: 1) Mineral production statistics accumulated by the Bureau from the mineral industry and summaries provided to the Division for purposes of publication; 2) Mining activities information shared by the Bureau and the Division, with provision for publication of such information by either organization or through a joint effort; and 3) Support of Division mineral resource investigation projects that require development of sub-surface data or specialized tests by the Bureau. Such support included our use of the atomic absorption equipment at their Reno Metallurgical Research Center, obtaining analytical data on copper-bearing samples.

U.S. Geological Survey

A cooperative, matching funds program between the Division and the Geological Survey was initiated in 1946. It provides for study of problems of mutual interest by personnel of either or both agencies, by mutual agreement, and for publishing the results of the projects. The project supported during 1969-70 was a continuing study by U.S.G.S. personnel of the active Garlock fault. Started in 1968-69, this study was in the report-preparation stage at the end of the fiscal year.

U.S. Army Map Service

Under an agreement initiated in 1968 and funded by the Army Map Service, the Division supplies gravity data to the funding agency. The Division utilizes these data in the compilation of the Bouguer Gravity Map series. Funds from the Map Service are provided for cooperative agreements with the University of California at Santa Barbara, the University of Oregon, and the Massachusetts Institute of Technology for furnishing gravity data to the Division. Field work under this agreement was completed, and data compilation continued.

Other Cooperative Activities

The U.S. Navy provided various data, facilities, and manpower to the Division staff in support of the Coso Hot Springs geothermal resources investigation. Additional support came from the National Aeronautics and Space Administration. A report on the interpretation of remote sensing in the Coso Hot Springs area is being prepared as a cooperative effort with the Navy and the Geological Survey.

The Navy continued its support to the revision of the Death Valley sheet of the State Geologic Atlas within the boundaries of the Naval Weapons Center, China Lake.

The Division continued and extended its traditionally close working relationships with scientists of many California universities and colleges. Division staff worked jointly on projects with the University of California at Santa Barbara and at Riverside, The Pennsylvania State University, Pomona College, and Stanford University. In addition, office space and access to libraries at Pomona College and the University of California at Berkeley, Davis, Los Angeles, Riverside, and San Diego (Scripps Institute of Oceanography) were utilized by Division staff.

Long-standing cooperation with the California Academy of Sciences continued in the fields of minerals research, meteorite investigations, instrumentation, and preparation of mineral exhibits at the Academy. Senior Geological Scientist Charles W. Chesterman continued to serve as Honorary Curator of Minerals, and former State Geologist Ian Campbell served on the Board of Trustees and has an office at the Academy.

The Division continued to cooperate with Federal, State, and local agencies, as well as with individuals, without written contracts or matching funds, often on an informal staff basis, by exchanging information on the geologic and mineral resources of the state. Many of the activities listed elsewhere in this Report have been supported by others.

BUDGET SUMMARY

Expenditures increased slightly more than 12 percent during fiscal year 1969-70 as shown on the following table. A significant part of the increase was provided by a budgeted augmentation to the Geologic Hazards Program. The total net expenditure was $1,404,810, compared with $1,251,887 in fiscal year 1968-69.

Expense Category		Expenditure
Salaries		$1,011,193
Operating Expenses		467,678
General Expense	$ 22,872	
Printing	88,333	
Communications	32,083	
Travel, Out-of-State	1,271	
Travel, In-State	32,876	
Motor Vehicle Operations	25,260	
Rent--Land and Buildings	138,408	
Rent--Aircraft	6,040	
Professional Services (Includes cooperative programs with the U.S.B.M. and U.C.)	67,433	
Purchase of Technical Reports	18,769	
Repair and Maintenance	992	
Engineering Reproduction and Photography	11,229	
Laboratory	7,542	
Library Services	2,687	
Specialized Training	275	
In-Service Training	211	
Agency Relocation	11,397	
Equipment		40,257
Cooperative Program with U.S. Geological Survey		2,250
Reimbursements		-116,568
TOTAL NET EXPENDITURE		$1,404,810

FUTURE PLANS

In keeping with its stated objectives, the Division plans to emphasize the useful application of geology to the activities, needs, and works of Californians for their greatest possible benefit. To assure that the limited resources of the Division are expended with maximum effect, priorities for the geologic and mineral resource requirements of the people of the state are being determined. Once established, these priorities must be regularly re-evaluated in light of the continuously changing economic and social environment of a dynamic citizenry living in a geologically diverse and complex state.

As one result of the realignment accomplished during the past year, a Program Planning Group was formed within the Division. It is charged with preparing or otherwise obtaining the forecasts necessary for making program priority judgments and for advance program planning and preparation. The Group is also responsible for evaluating projects and activities as to their conformance with over-all Division objectives. After an uncertain start in these duties, this unit rapidly gained experience and confidence during the last few months of the fiscal year and will play a key role in the Division's attainment of the goals outlined here.

Also accomplished during the realignment was a "winnowing out" of many lower priority projects and activities, as well as a redistribution of supervisory responsibility and authority to positions closer to the work in progress. These adjustments should accelerate the completion of useful geologic products in the future.

To some casual observers, the past year may appear to have been more eventful than productive for the Division; we intend to reverse any such appearance in the year ahead.

Wesley G. Bruer
STATE GEOLOGIST

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